A FISHERY RESOURCE INVENTORY
OF THE
LOWER HACKENSACK RIVER
WITHIN THE HACKENSACK MEADOWLANDS DISTRICT

A COMPARATIVE STUDY
2001-2003 vs. 1987-1988

New Jersey Meadowlands Commission
Meadowlands Environmental Research Institute

by

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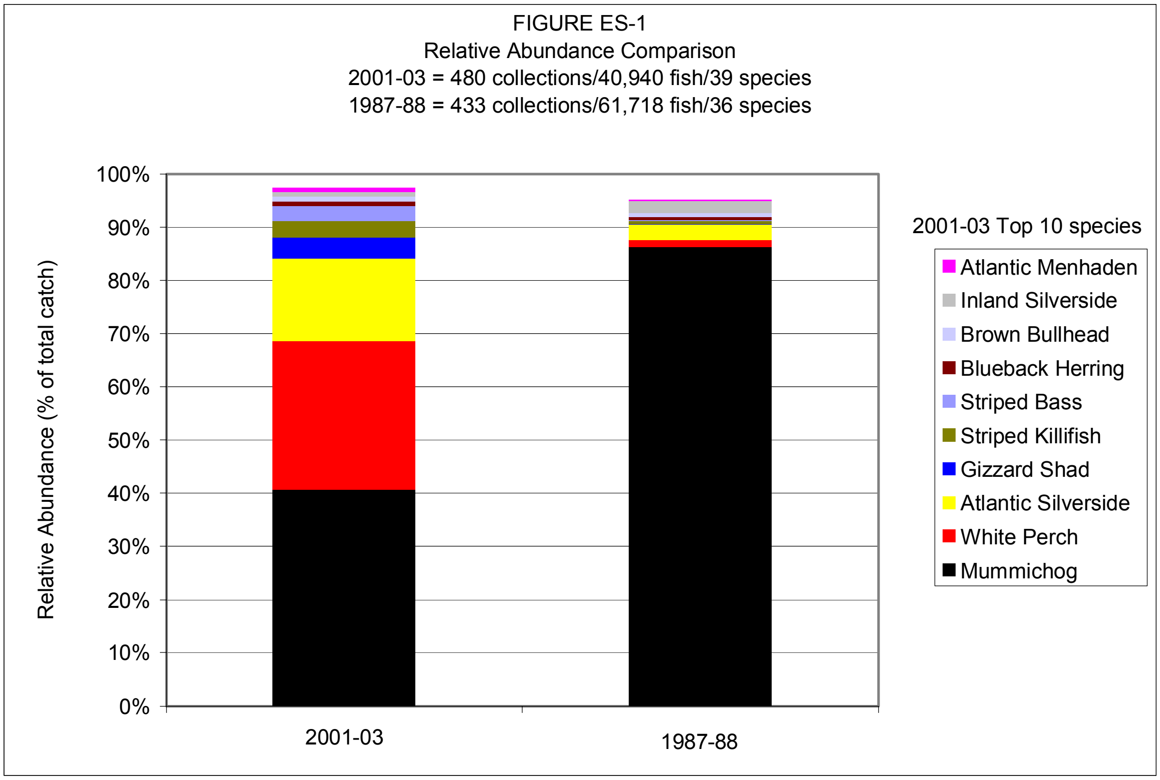
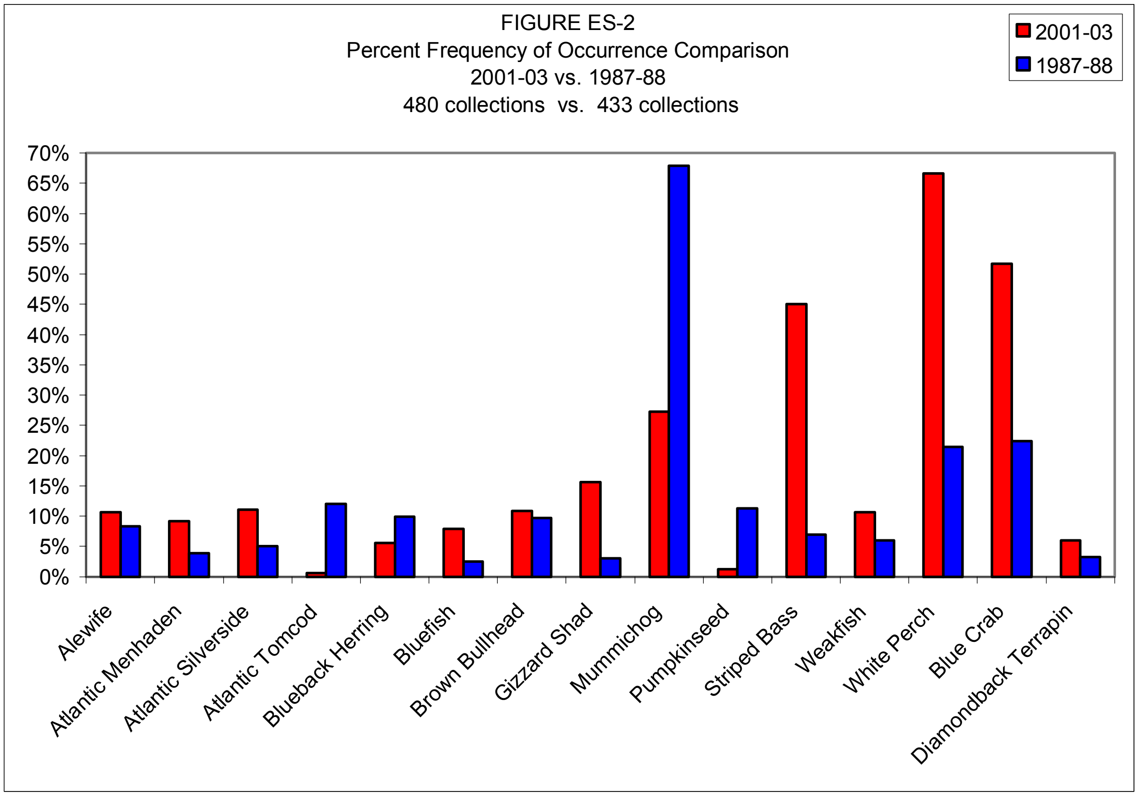
EXECUTIVE SUMMARY

Between August 2001 and September 2003, the NJMC/MERI conducted a fish inventory of the Hackensack River and some of its larger tributaries. Four different gear types were used to make the fishery collections. Fishery collections and water quality data were collected from a total of 21 sampling locations (Attachment A). Each location was sampled monthly during the first year (August 2001 to July 2002), and seasonally during the second year (October 2002 to September 2003). A total of 40,940 fish, representing 39 species were identified from 480 collections. As expected in a brackish estuary, the minnow-sized mummichog was the most abundant species captured. Large numbers of white perch, Atlantic silverside, and gizzard shad were also collected during the study.

The data collected during the current investigation were compared to a similar fish inventory conducted during 1987-1988 by the NJMC. During the 1987-88 study, a total of 433 collections were made, and a total of 61,718 fish from 36 species were collected. Figure ES-1 shows a comparison of the relative abundance of the 10 most abundant species collected during the 2001-03 study versus the 1987-1988 study. This comparison reveals that a change in the community structure has occurred during the 15 years between the two studies. The mummichog was overwhelmingly dominant in 1987-88, comprising over 85% of all fish caught. Although the mummichog remained the most common fish in 2001-2003, it comprised only about 40% of all fish. Other striking differences include the increase in the abundance of white perch (which increased from 1% of the catch during the 1987-88 study to 28% during the current study); the Atlantic silverside (which increased from 3% to 16%); the gizzard shad (which went from 0.1% to 4%); and the striped bass, (which increased from 0.1% to 3%). These results show that while many of the same species still use the River, there is a more even distribution amongst the most common species. The River is no longer overwhelmingly dominated by the mummichog (a pollution tolerant species) and the fish community has gained more desirable game species. The more even distribution of species within the fish community is a sign of increased community stability. This means the community has an increased ability to be unaffected (or less severely affected) should a disturbance of one or more of its components occur.

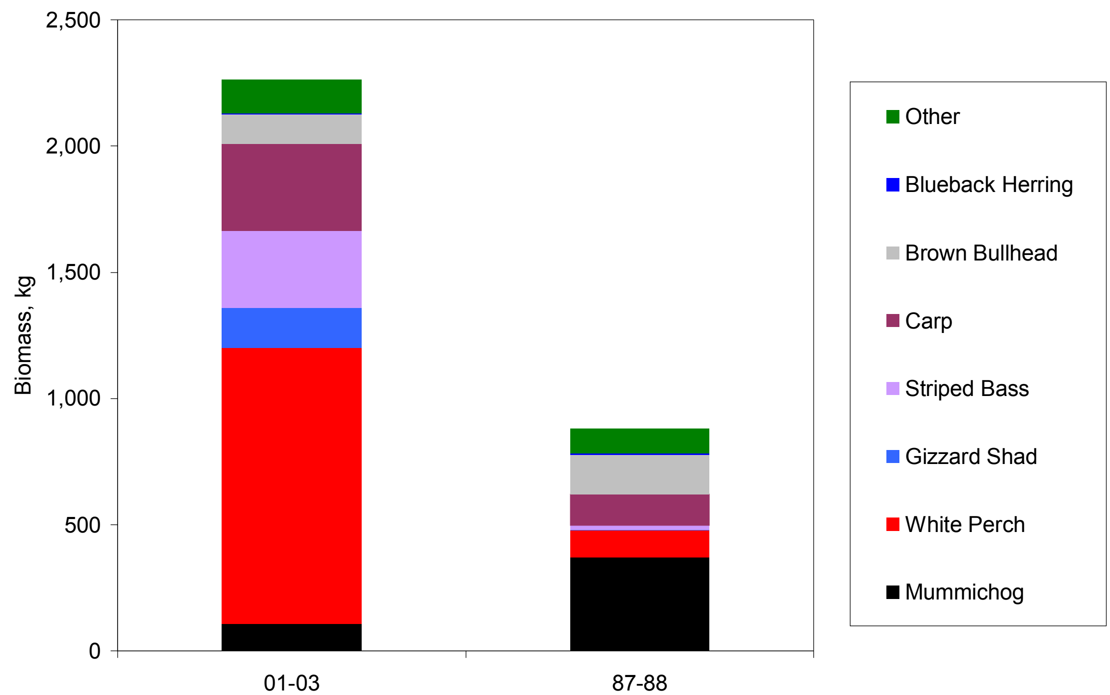


The frequency that each species was captured (i.e., the number of collections that yielded a particular species) during each of the two studies was also compared. Figure ES-2 shows a comparison of the percent frequency of occurrence of selected fish species (as well as blue crab and diamondback terrapin) for both time periods. From this chart it is easy to see the large differences in the frequency with which the white perch, striped bass, gizzard shad and blue crab were captured during the 2001-03 collections compared to the 1987-88 collections. For example, the white perch was captured in 320 of the 480 collections made during the 2001-03 investigation (67%), while it was only present in 93 of the 433 collections made during the 1987-88 study (21.5%). Figure ES-2 also clearly shows the difference in the frequency of the mummichog between the two studies. Some of the species that were captured more frequently in 1987-88 compared to 2001-03 include the Atlantic tomcod, blueback herring and pumpkinseed.



Although a larger total number of fish were collected during the 1987-88 study vs. the 2001-03 study, the large majority in 1987-88 were mummichogs. In contrast, many more large fish (e. g., striped bass, white perch, carp) were collected during the 2001-03 collections. Therefore, it is revealing to calculate and compare the biomass of fish captured (Figure ES-3). This comparison showed a very large (157%) increase in biomass in the current study. Desirable game species such as the white perch and striped bass (along with carp) comprised the largest percentages of biomass in 2001-03; by contrast, in 1987-88, mummichog, brown bullhead (a medium sized fish) and carp (all pollutant tolerant fish) comprised the largest percentages of biomass.

FIGURE ES-3
Total Biomass by Species
2001-03 vs. 1987-88



To determine if the change in the fish community between 2001-03 and 1987-88 was significant, we calculated several statistics of community structure (Simpson's diversity index, Shannon-Wiener diversity index and an evenness index) and these data were analyzed using an adapted t-test to statistically compare the fish community data. This analysis revealed that the difference between the 1987-88 and 2001-03 fish communities for all 21 locations combined was highly significant (at p=0.01). Further analysis compared pooled data from the lower, middle and upper sections of the River and from the tributaries. This analysis revealed that the fish community in the middle and upper portion of the River was significantly different in 2001-03, but the fish community in the tributaries and in the lower portion of the River was not.

The improvement seen in the fish community in the upper and middle River is likely related to changes in the industrial use of the River that have occurred since the 1987-88 study was completed. During 1995, PSE&G's Bergen Generating Station stopped withdrawing approximately 645 million gallons per day of water from Overpeck Creek. This withdrawal was used as once-through cooling water for the Station, with heated water discharged back into the Hackensack River. The discontinuation of this withdrawal has nearly completely eliminated the loss of fish and invertebrates by impingement and entrainment, and appears to have had a positive impact on the fish community in the upper (and even the middle) portion of the River, which is a spawning and nursery area for the white perch.

Another improvement in the upper portion of the River is related to a "beneficial re-use project" that was initiated around the same time as the power plant retrofit. The BCUA Little Ferry Sewage treatment plant began to send a portion of its effluent to the Bergen Generating Station for re-use as cooling water.

Unfortunately, in the lower portion of the River, the use of the River's water for industrial cooling and the legacy of contaminated industrial sites yet remain, and no improvement in the fish community was seen.

With regard to water quality, the following variables were measured near the water surface (and bottom) during each collection: temperature, salinity, dissolved oxygen and water clarity (depth to which a "Secchi disk" could be seen). The average values of the surface readings are graphed by site for 1987-88 and 2001-03 in Figure ES-4.

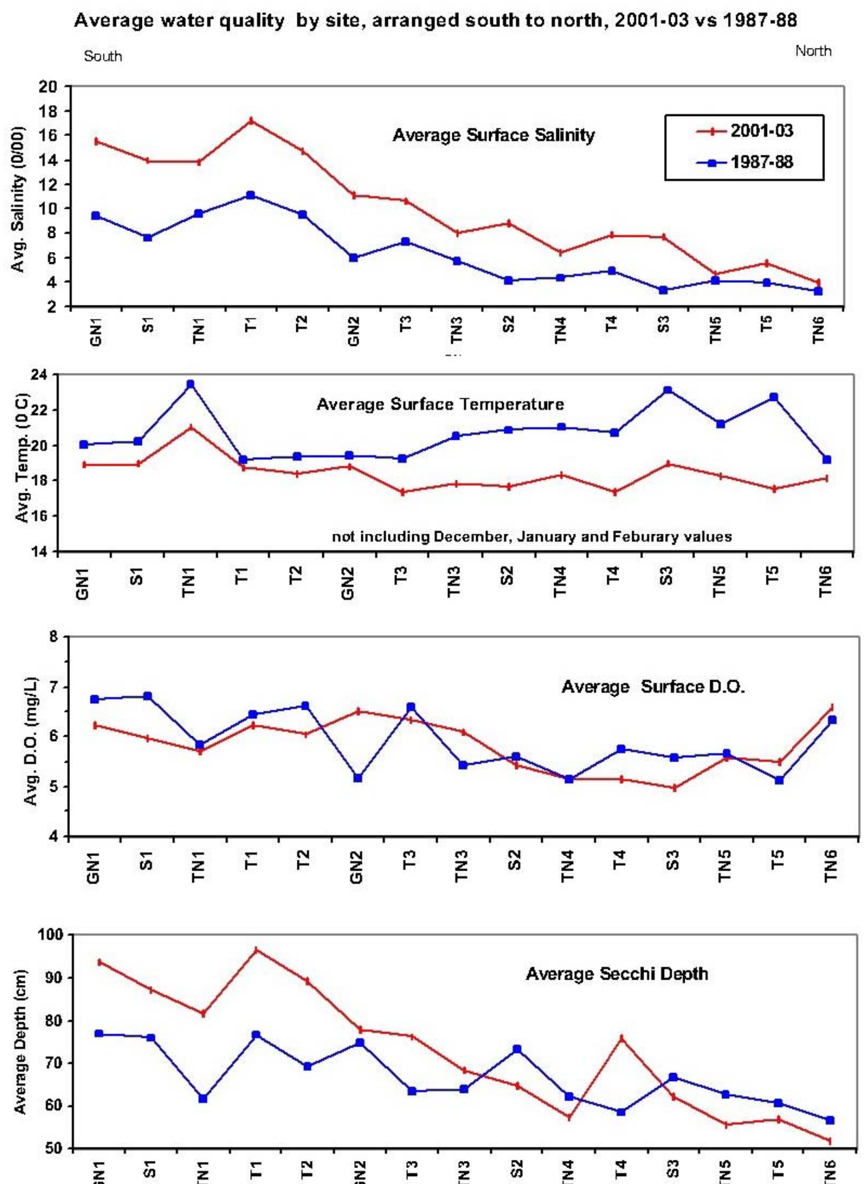
The average salinity was higher at all sites in 2001-03 vs. 1987-88, due to the drought that occurred from April 2001 - September 2002. The difference was most pronounced (about 6 parts per thousand, ppt, in the average) near the downriver (southern) boundary of the study. Overall, the average salinities in the Meadowlands remained in the medium-salinity or "mesohaline" range (i. e., 5 to 18 ppt) during both studies. Salinity decreases as one moves upriver, with the average salinity around 5 ppt at the northern end of the Meadowlands District in both studies.

A temperature spike at site TN1 near the southern end was observed during both studies, likely due to the discharge of heated water by the nearby power plant. In 1987-88, high temperatures were also observed in the upriver (northern) area (S3, TN5 and T5), again likely caused by a discharge from a nearby power plant. However, as mentioned above, this discharge was discontinued in the years between the two studies, and so, average temperature at T5, for example, was markedly lower (5C, 9F) in 2001-03. Elevated temperatures are undesirable because warmer water is not able to hold as much dissolved oxygen as cooler water can.

With regard to dissolved oxygen (DO), there was no consistent pattern in the differences between the two studies regarding average concentrations. However, DO concentration is a highly dynamic variable, varying widely throughout each day from photosynthesis of algae during daylight pumping oxygen into the water, and plant respiration consuming oxygen during the night. Given that sampling times were not highly controlled during the two studies, it is not tenable to make conclusive statements about how DO compares between the two studies. It is encouraging to note that, in 1987-88, 33% of all DO readings were less than the regulatory criteria of 4 mg/l, but this percentage fell to 23% for 2001-03.

No consistent pattern in the differences between the two studies was evident for water clarity. Water clarity was greater in 2001-03 vs. 1987-88 at the downriver sites, but was slightly more turbid at the upriver sites. However, there was a nearly consistent spatial pattern during both studies: water clarity decreases as one moves upriver.

Figure ES-4



Average water quality by site, arranged south to north, 2001-03 vs 1987-88
South
North
Average Surface Salinity
2001-03
1987-88
Avg. Salinity (0/00)
Average Surface Temperature
Avg. Temp. (0 C)
not including December, January and Feburary values
Average Surface D.O.
Avg. D.O. (mg/L)
Average Secchi Depth
Average Depth (cm)
GN1
S1
TN1
T1
T2
GN2
T3
TN3
S2
TN4
T4
S3
TN5
T5
TN6

Attachment A
Map of Fish Collection Locations